



# Aerosol and Cloud Spatial Distributions and Microphysical Properties

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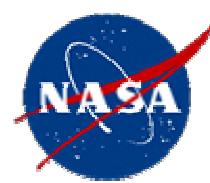
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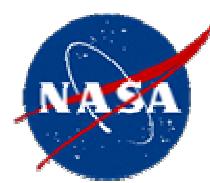
## LaRC INTEX-NA Objectives

- Obtain high quality in situ measurements of aerosol and cloud particle number densities, volatility, size distribution and optical properties
- Use collected data to identify and characterize North American aerosol sources and sinks and to examine evolution of aerosol properties during transport
- Investigate links between background aerosols and cloud microphysical properties
- Evaluate active remote sensor algorithms that derive aerosol extinction from backscattering measurements



## INTEX-NA Mission Preparation

- Questions regarding DC-8 aerosol inlet transmission efficiency were raised based on TRACE-P platform intercomparisons
- Large particles were anticipated to comprise a sizeable fraction of INTEX-NA aerosol loading in some circumstances
- NASA HQ sponsored mission in 2003 to evaluate performance of potential DC-8 aerosol inlets
- DC-8 Inlet Characterization Experiment (DICE) led by LaRC and included participants from UH, UNH, GIT, LaRC and CIT

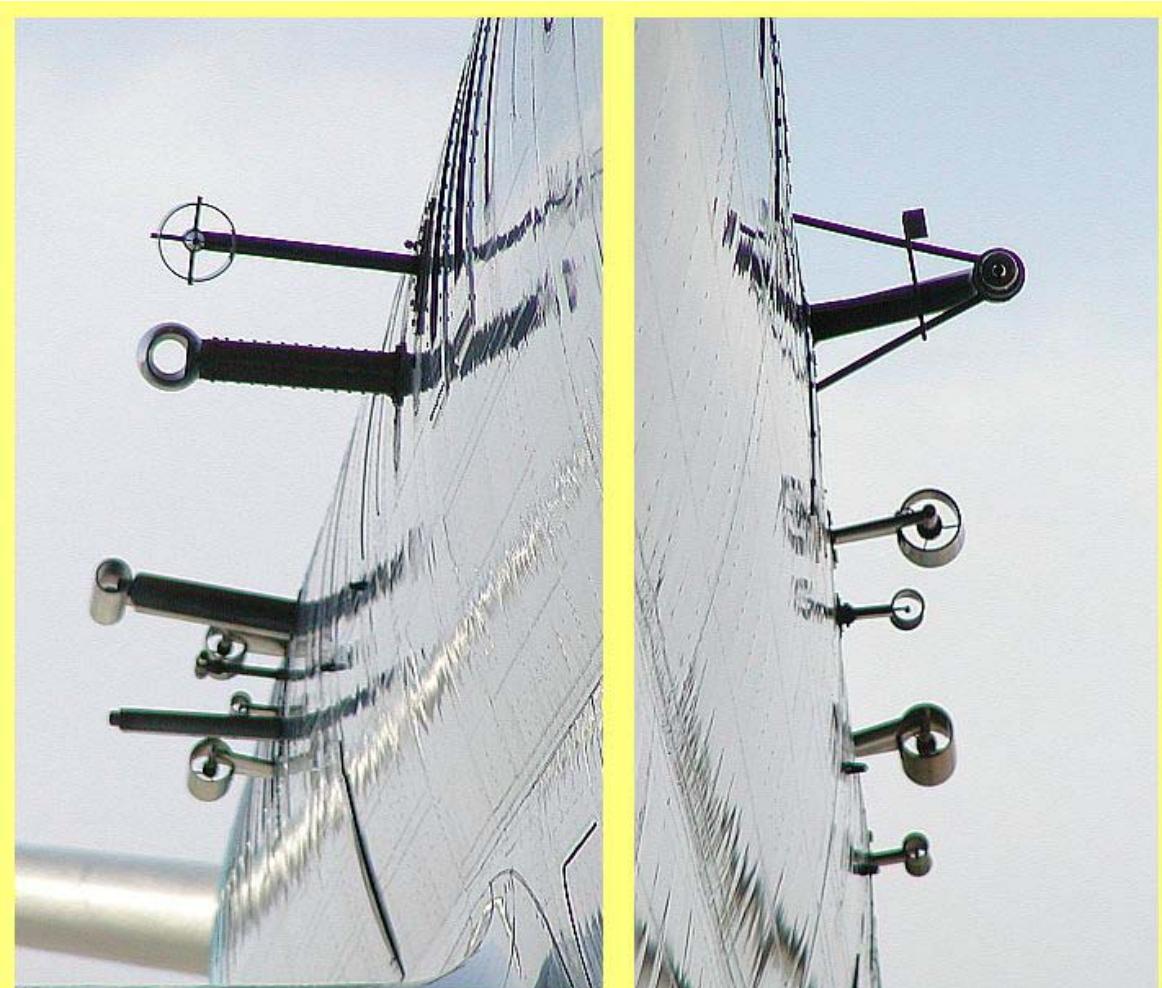


## DICE: Experiment Plan

- Installed LaRC, UNH and UH inlets on DC-8 during May 2003 at NASA DFRC
- Connected each inlet to an identical set of instruments to measure particle size, number density and scattering coefficients; placed an additional set of instruments on Edwards Tower
- Performed 8 flights, wherein we flew by Eddie Tower (dust) and Trinidad Head (sea salt) NOAA station
- Also compared relative inlet transmission efficiencies while sampling marine, industrial, and agricultural air masses



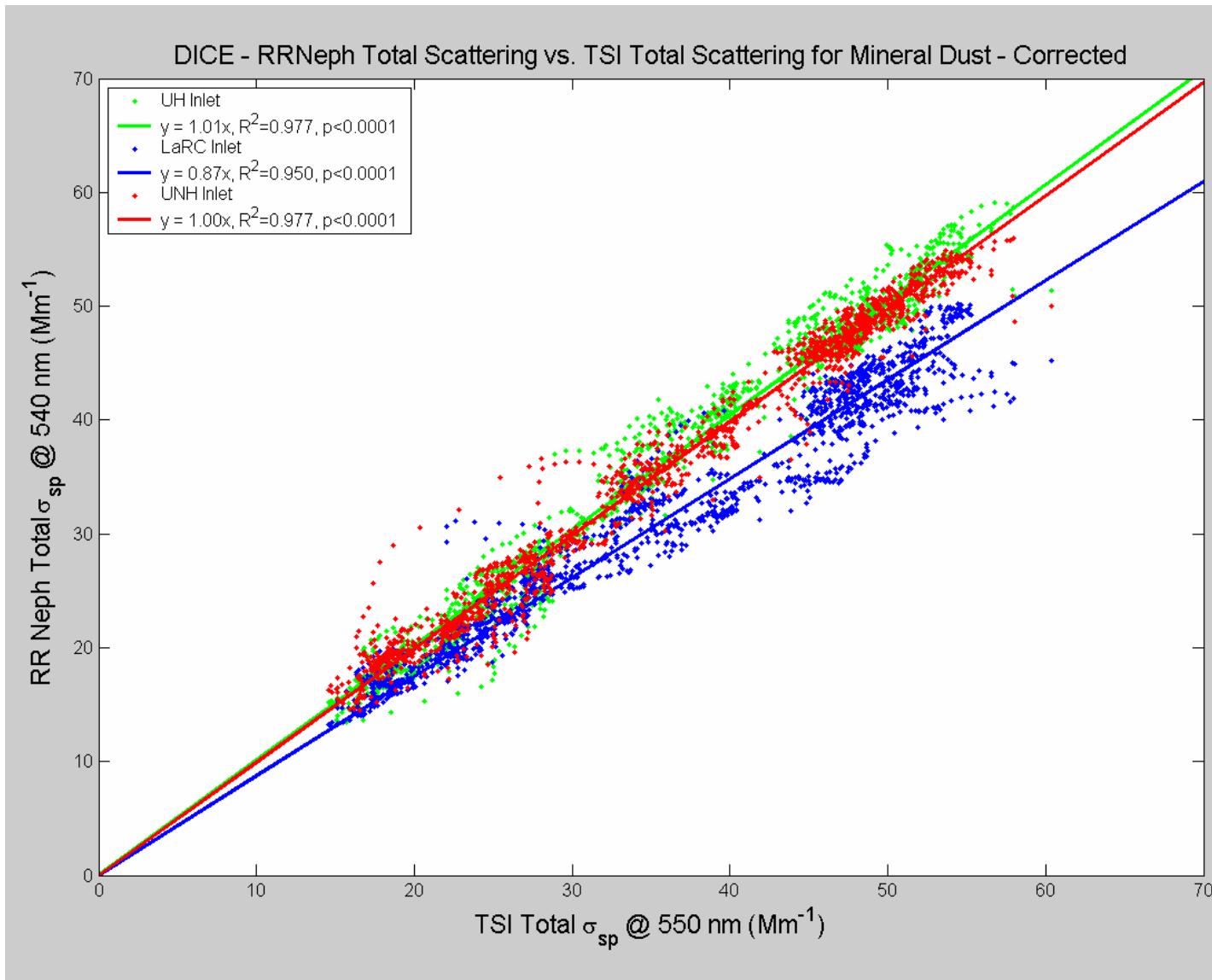
## DICE: Experiment Plan



DC-8 DICE/LRR Window-mounted Air Sampling Probes



# DICE Inlet Inter-comparisons

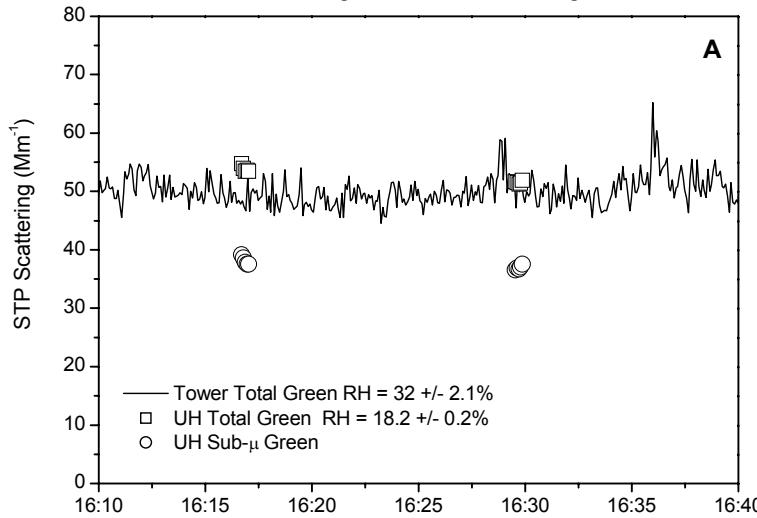




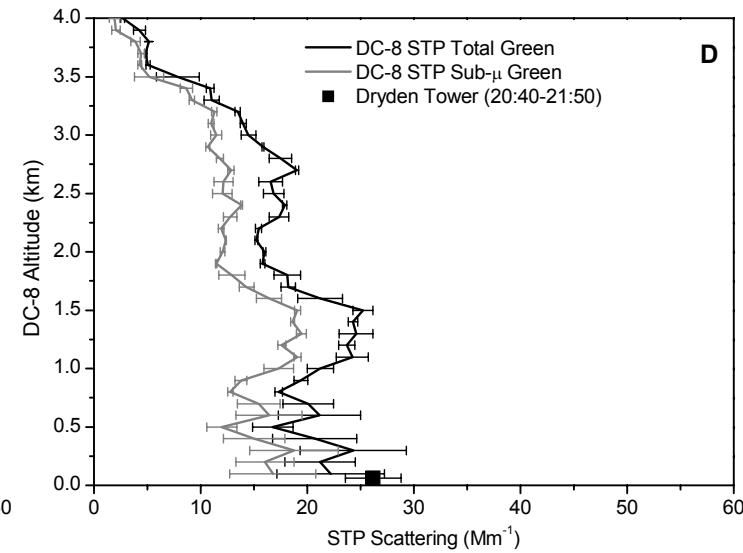
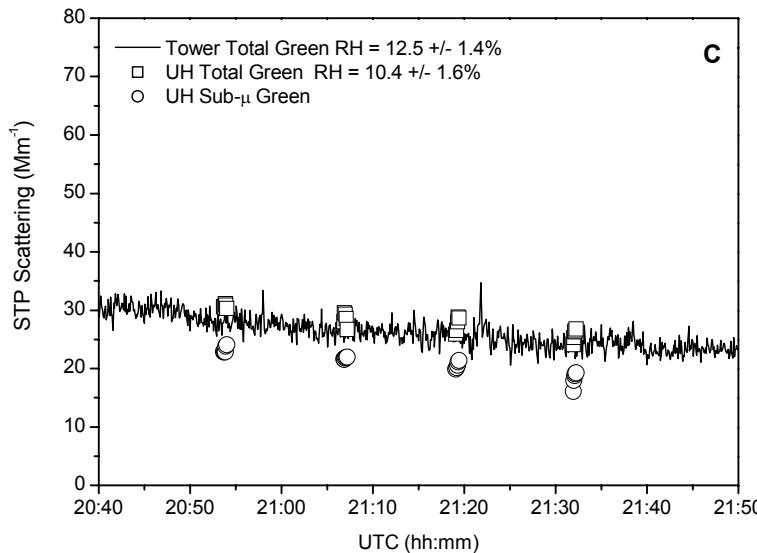
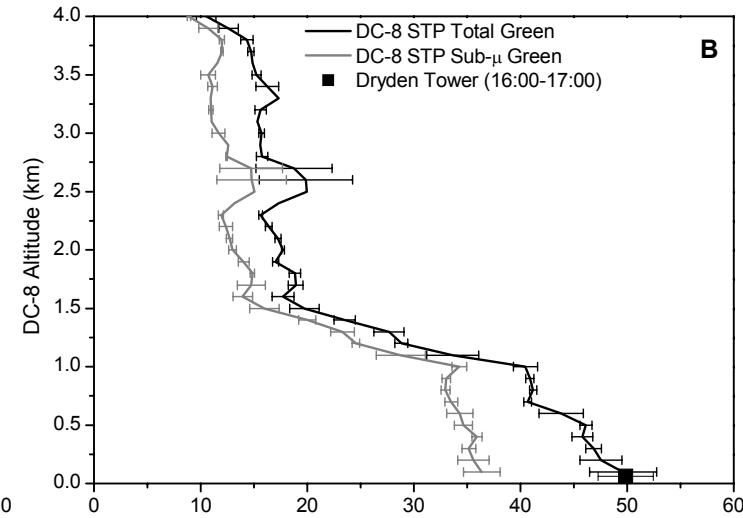
# DICE DC-8 versus Ground Station

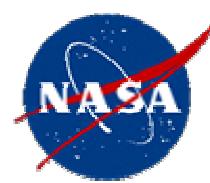
DICE - RF08 - 06/17/2003

UH Scattering vs. Tower Scattering



RF08 - Scattering Profiles over Dryden





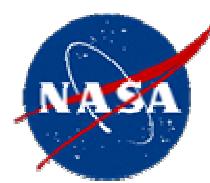
## DICE Description and Detailed Results

1) See <http://www-gte.larc.nasa.gov/dice/>

- Flight reports
- White paper
- Experiment plan
- Cool video clips

2) See Cameron McNaughton's Poster

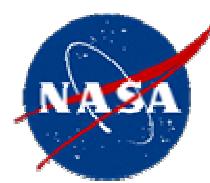
- Comparison of Inlets
- Comparison of DC-8 with Eddie Tower and Trinidad Head



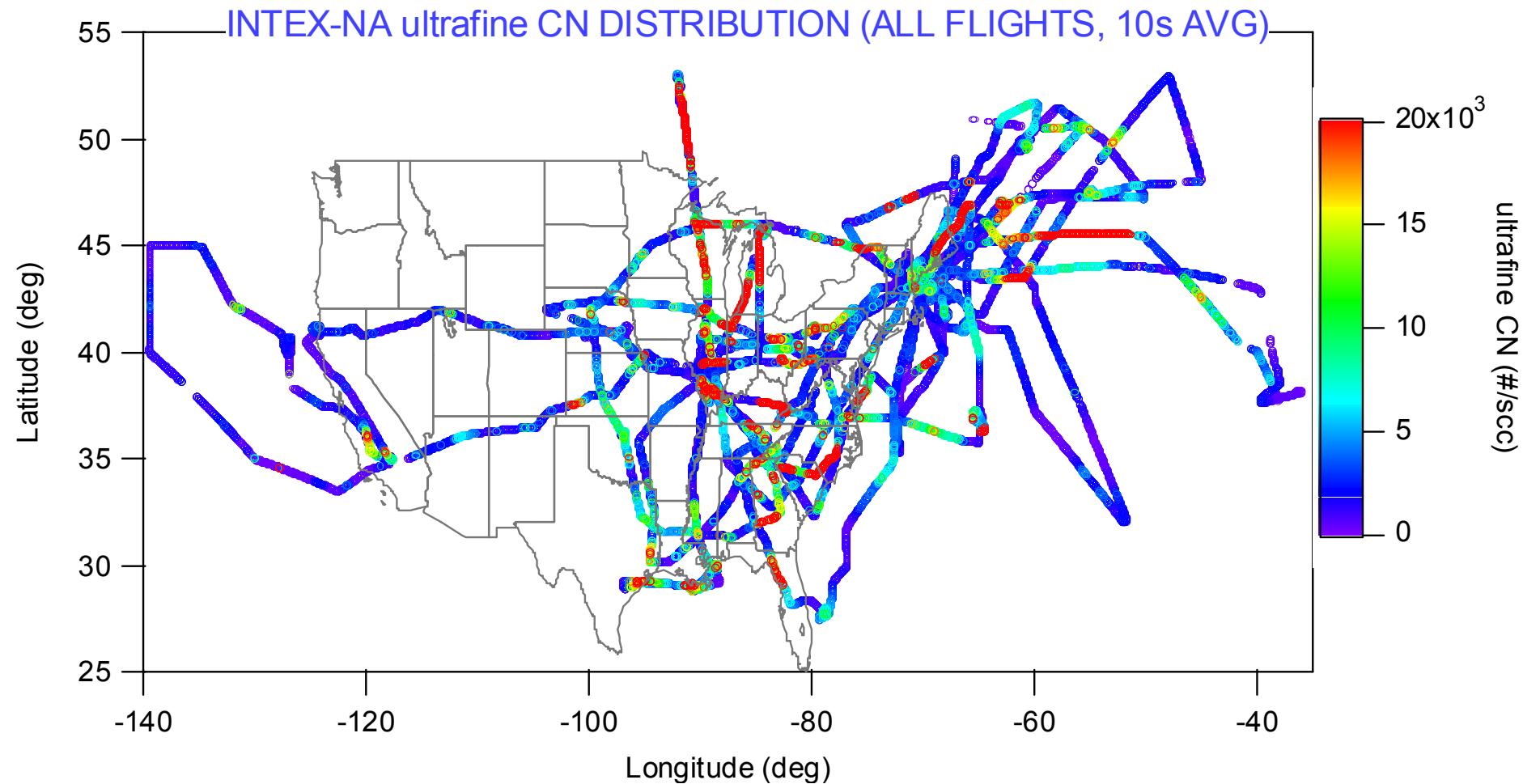
## LaRC Instruments (shared with UH)

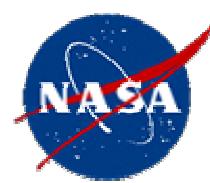
| Measured Parameter                                    | Instrument         | Size Range<br>(microns) | Response<br>(seconds) | Precision             |
|---|--------------------|-------------------------|-----------------------|-----------------------|
| Total and Ultrafine Aerosols                          | TSI 3025, TSI 3010 | 0.003 - 0.01            | 1                     | 10%                   |
| Aerodynamic Particle Size                             | TSI 3321           | 0.5 - 10                | 1                     | 20%                   |
| Light Scattering Coefficients at 450, 550, and 700 nm | TSI 3563           | < 10                    | 1                     | 1 e-6/m               |
| Black Carbon  | PSAP               | < 10                    | 10                    | 100 ng/m <sup>3</sup> |
| Ambient Aerosol Size                                  | PMS FSSP-300       | 0.4 - 20.0              | 1                     | 30%                   |
| Cloud Particle Size                                   | DMT CAPS           | 0.6 - 1550              | 1                     | 30%                   |
| Cloud Liquid Water Content                            | DMT CAPS           | -                       | 1                     | .01 g/m <sup>3</sup>  |

17 total Instruments!

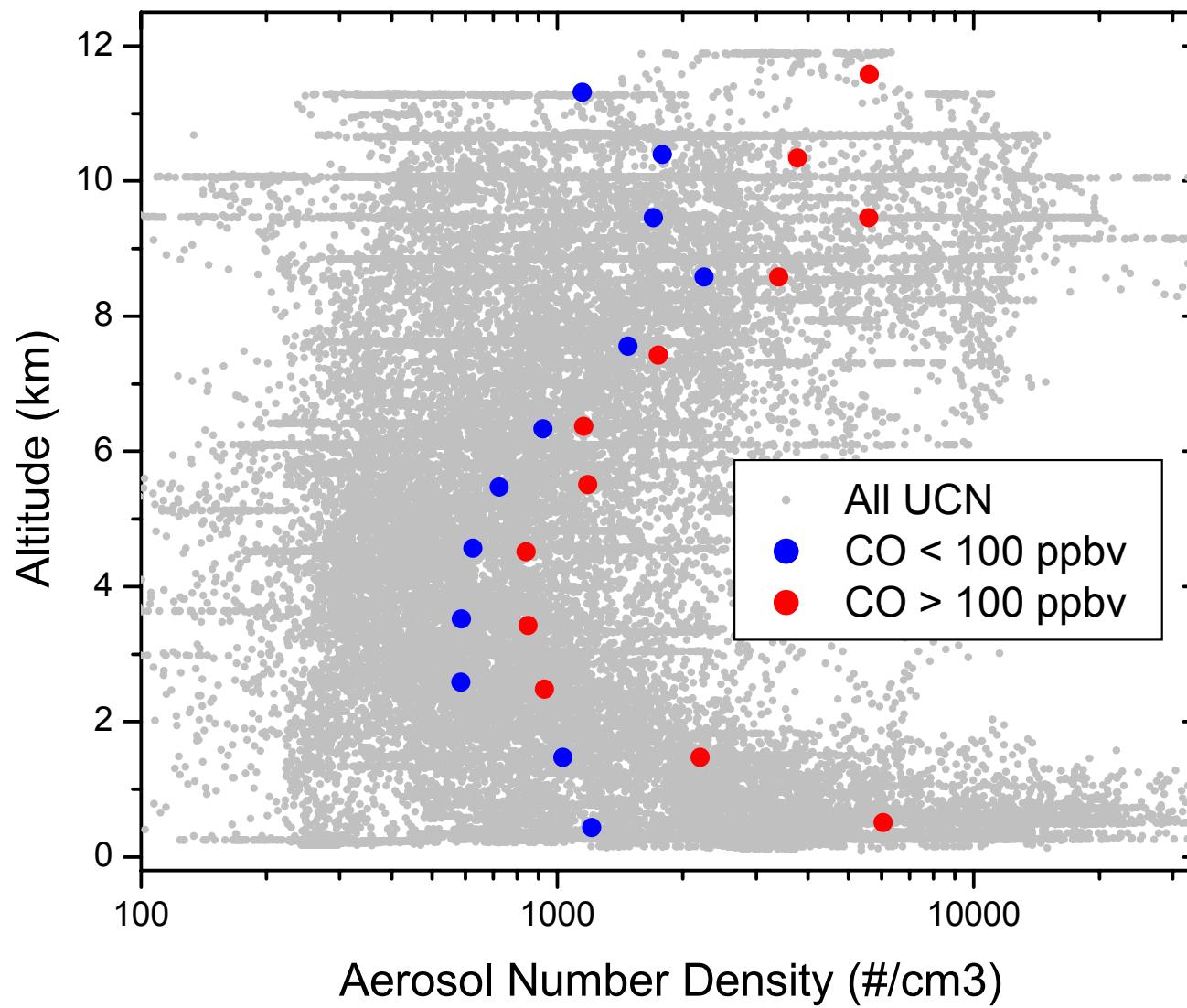


# Spatial Variations in Aerosol Density



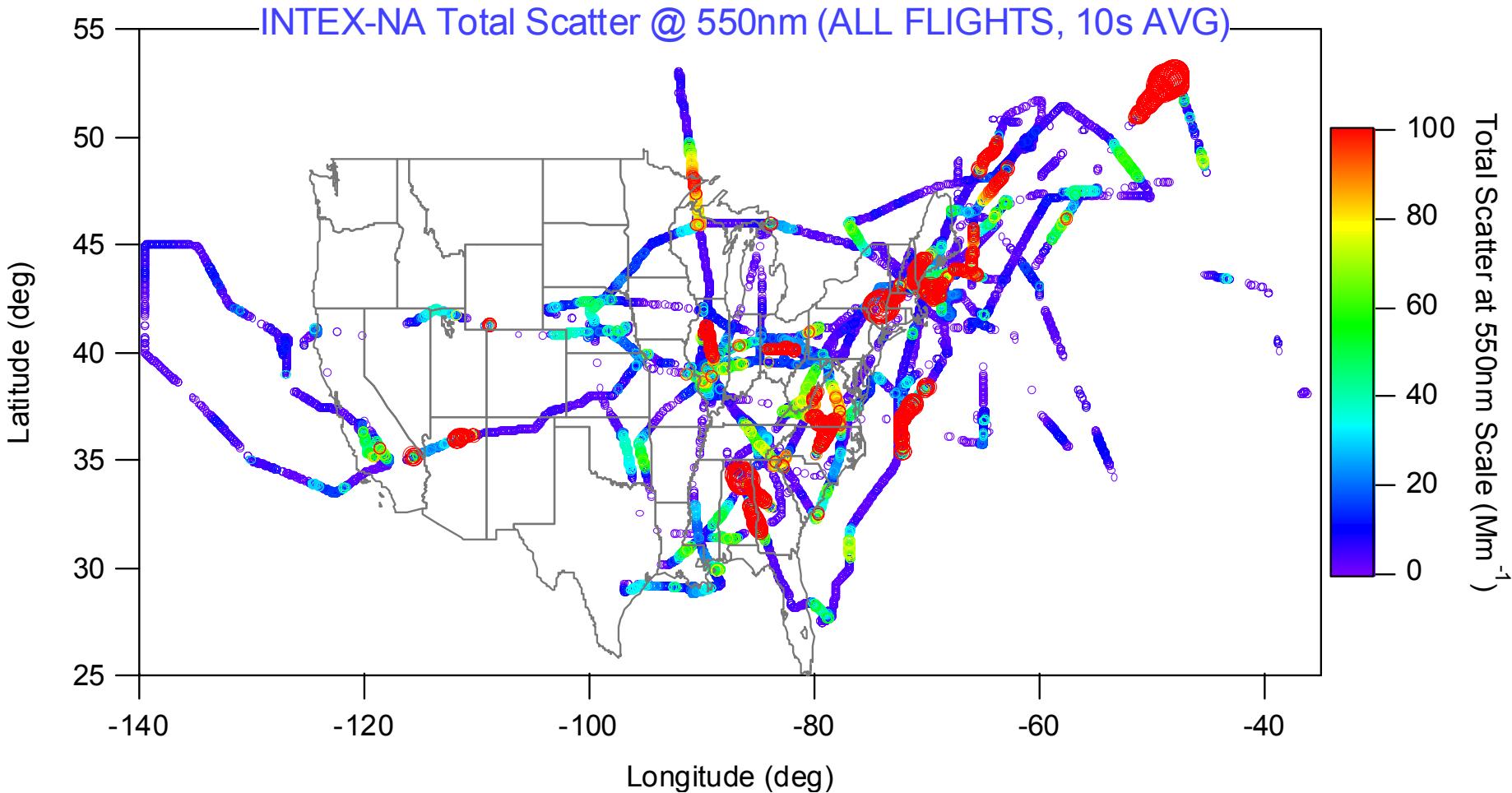


# Anthropogenic Effects upon Aerosol Density



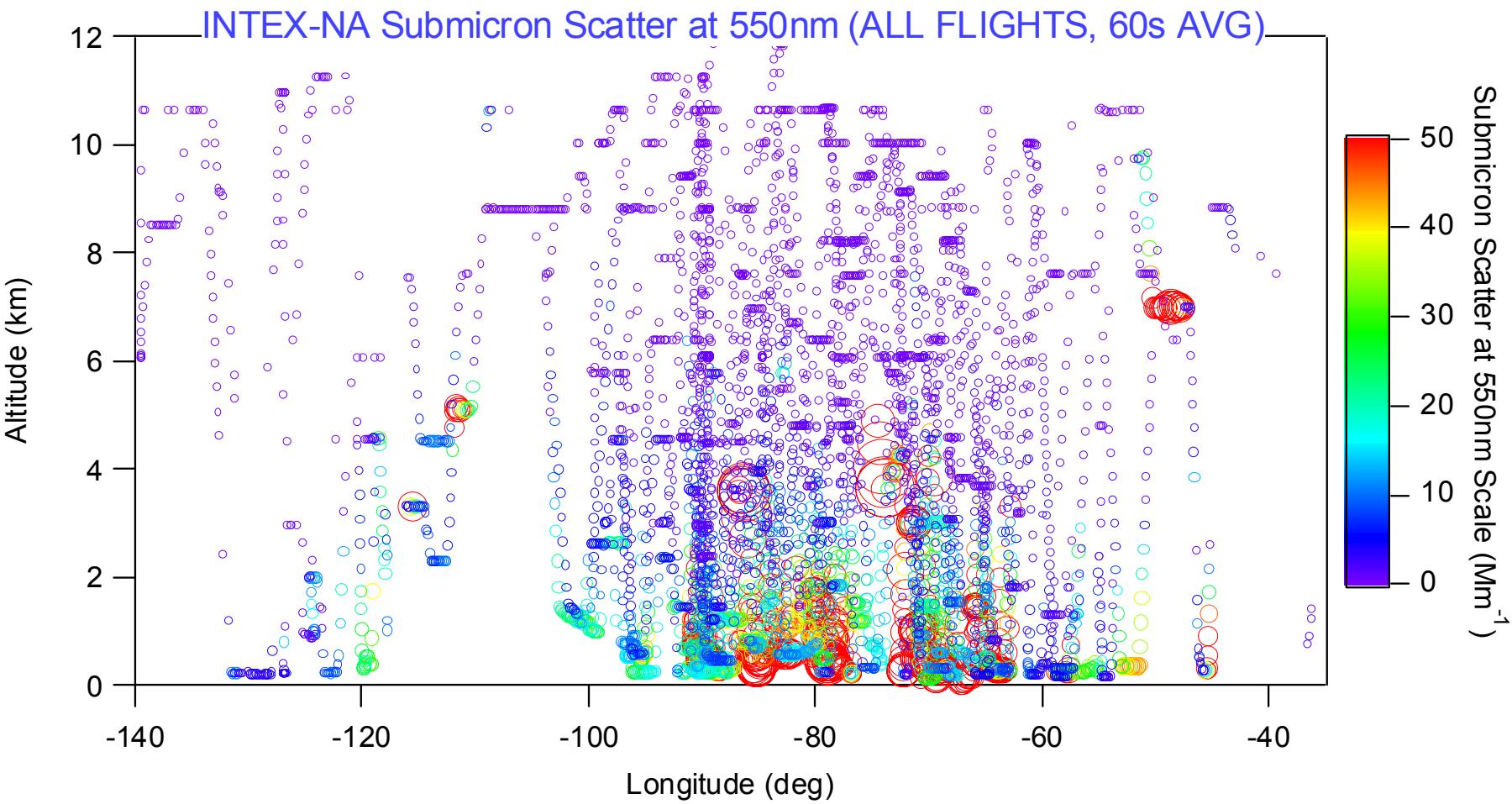


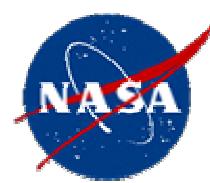
# Spatial Variations in Aerosol Scattering



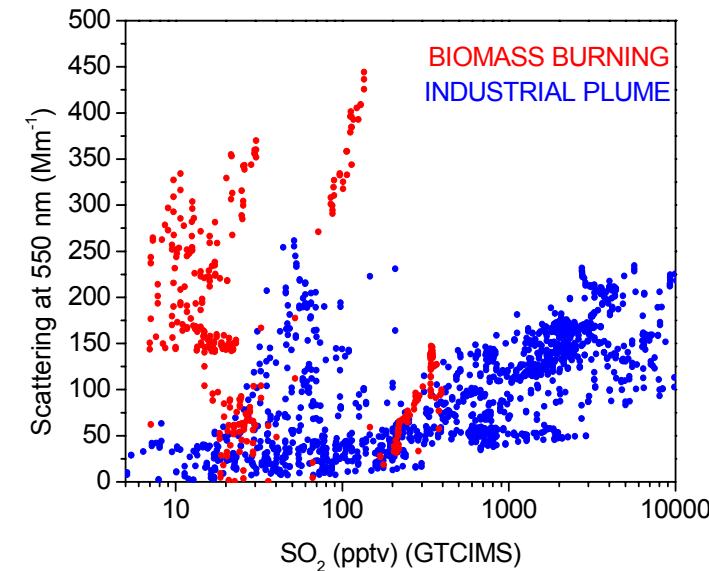
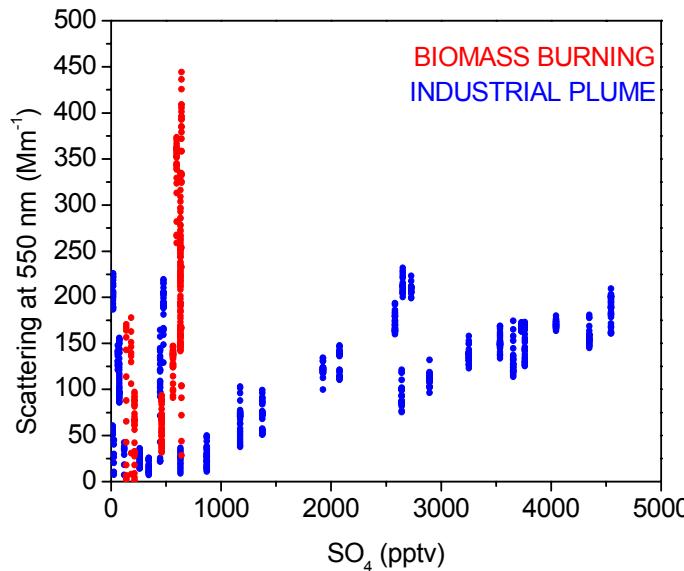
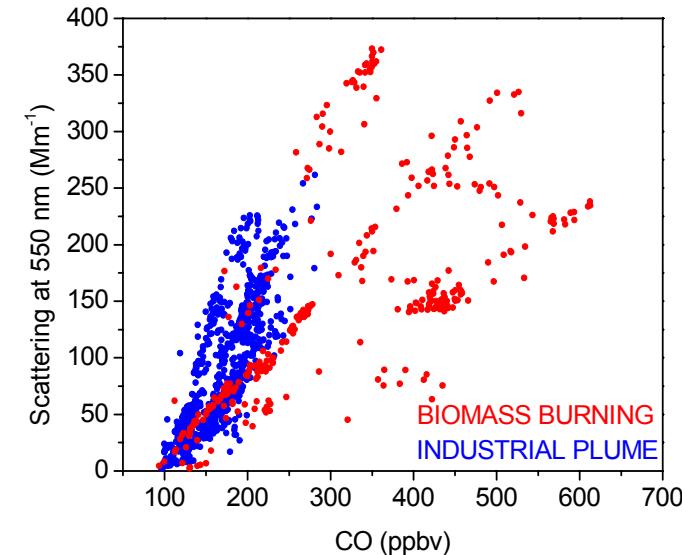
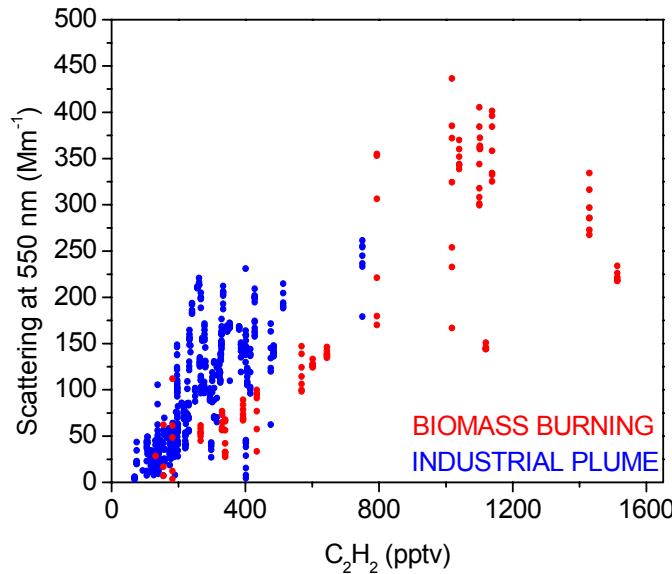


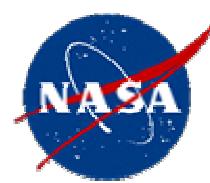
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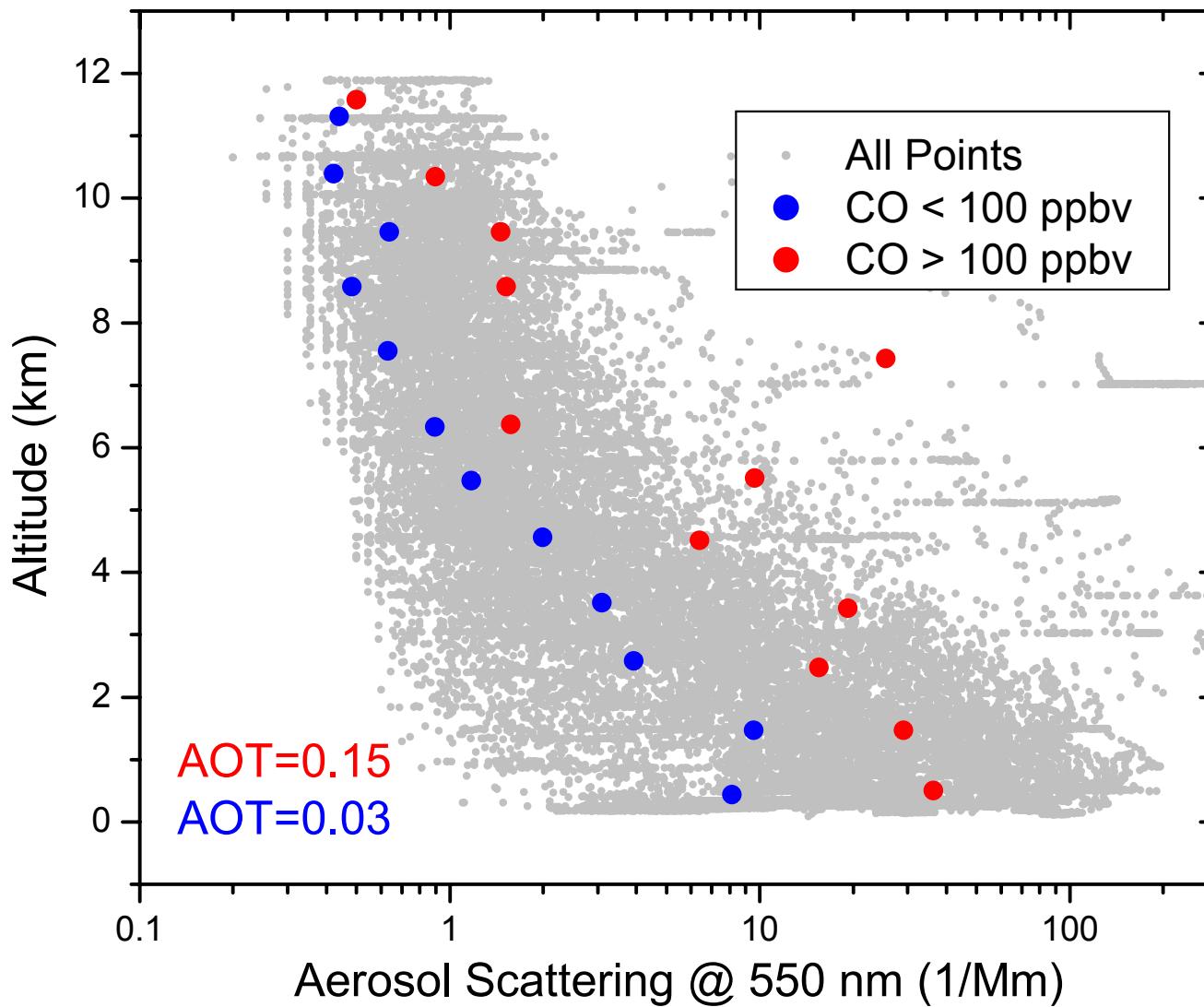


# Aerosol Source Characteristics



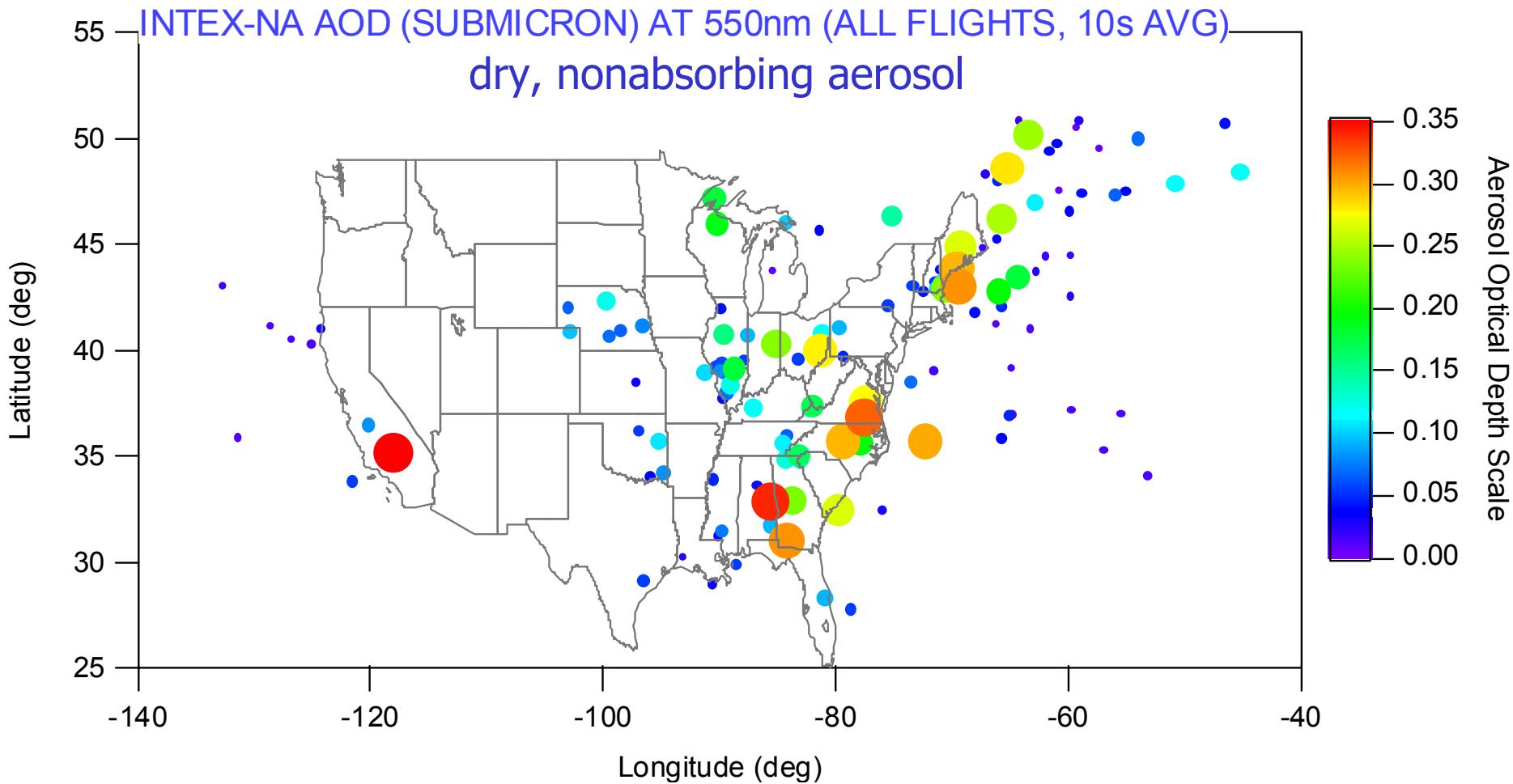


# Anthropogenic Effects upon Aerosol Scattering





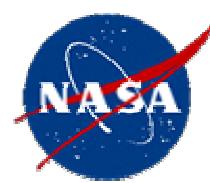
# Continental Aerosol Impact on Radiative Forcing



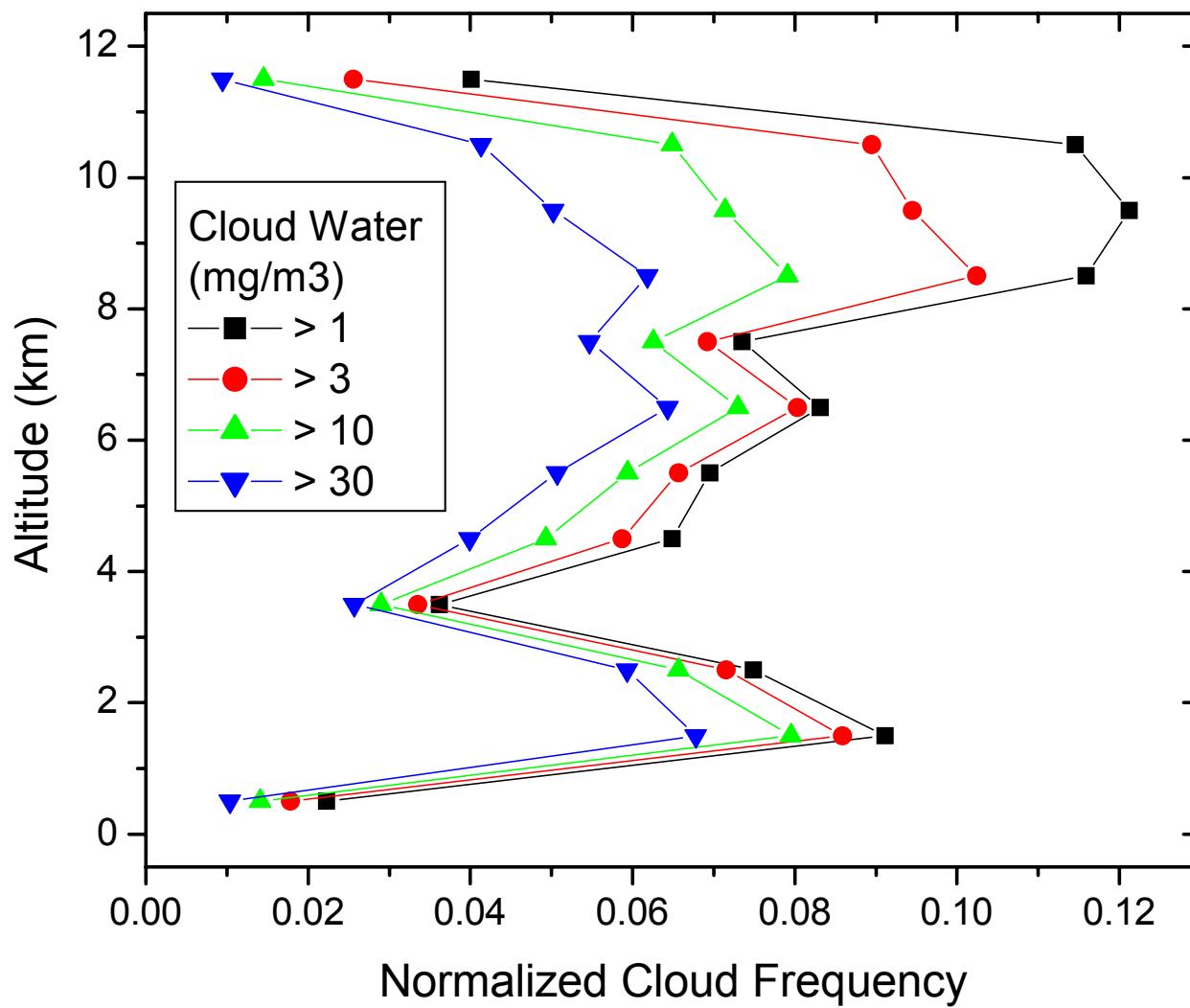


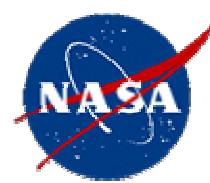
# INTEX-NA DC-8 Cloud Observations



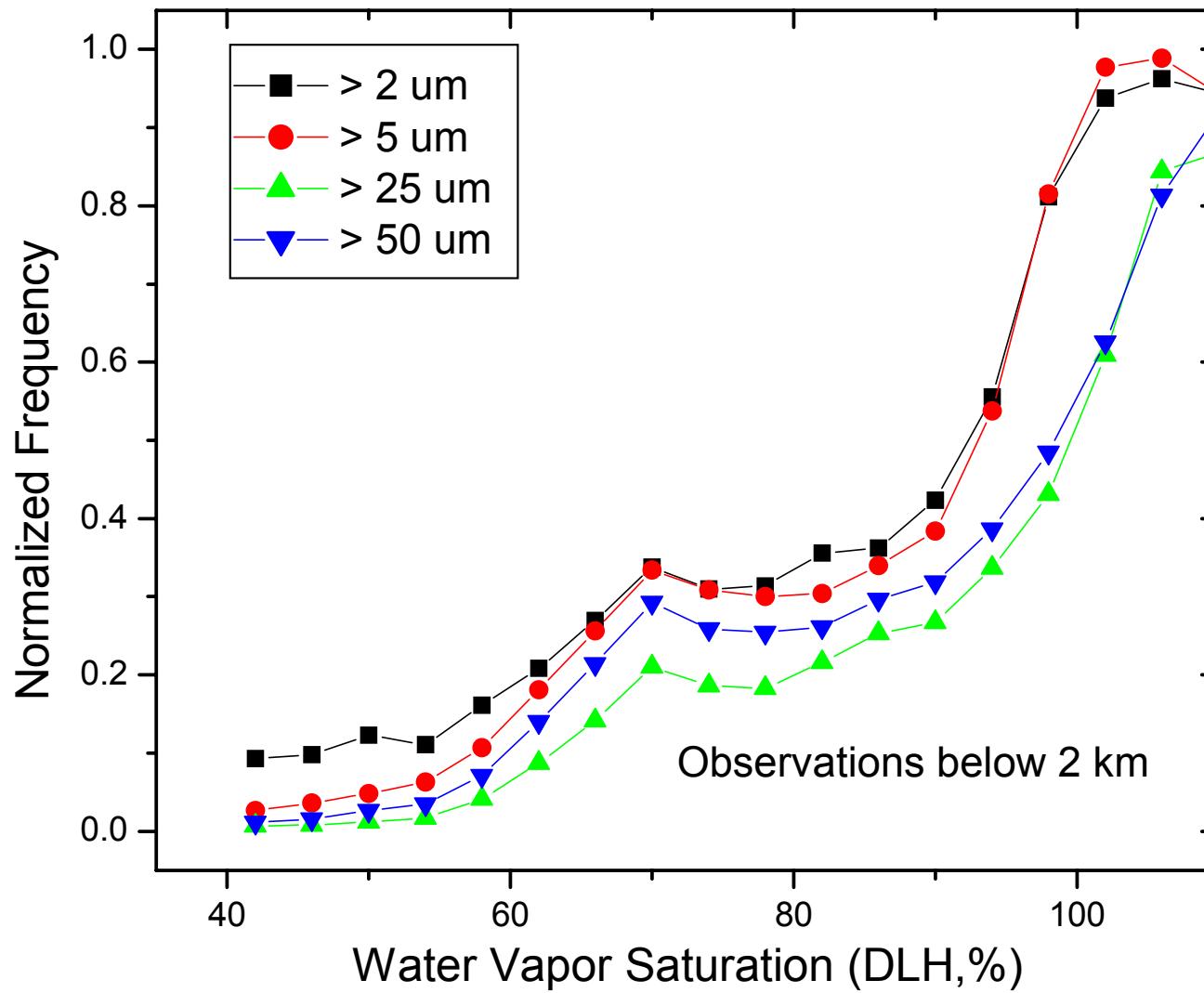


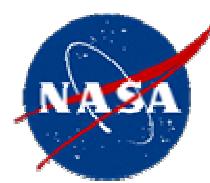
# INTEX-NA DC-8 Cloud Sampling Frequency



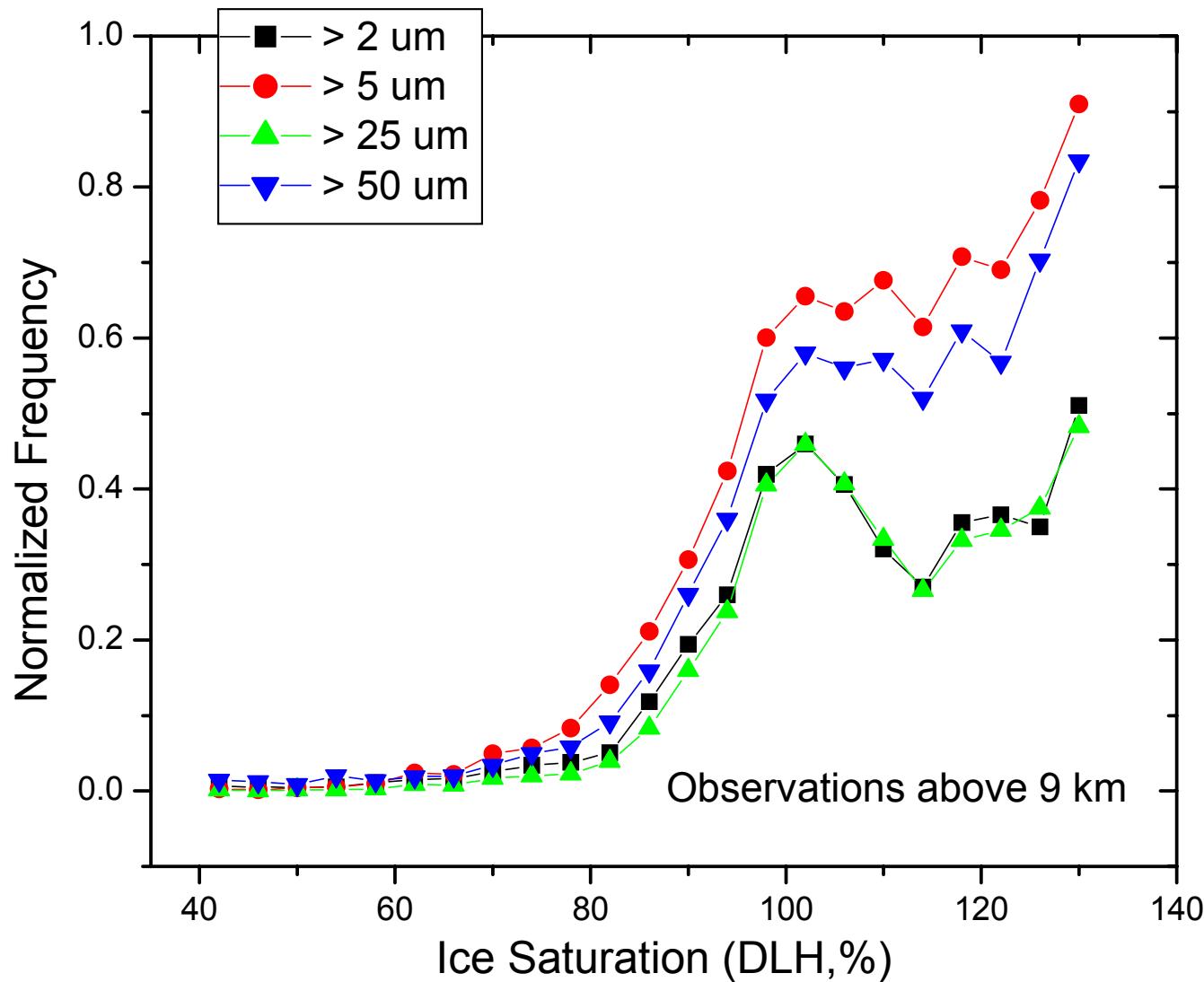


# Warm Cloud Relationship with Humidity



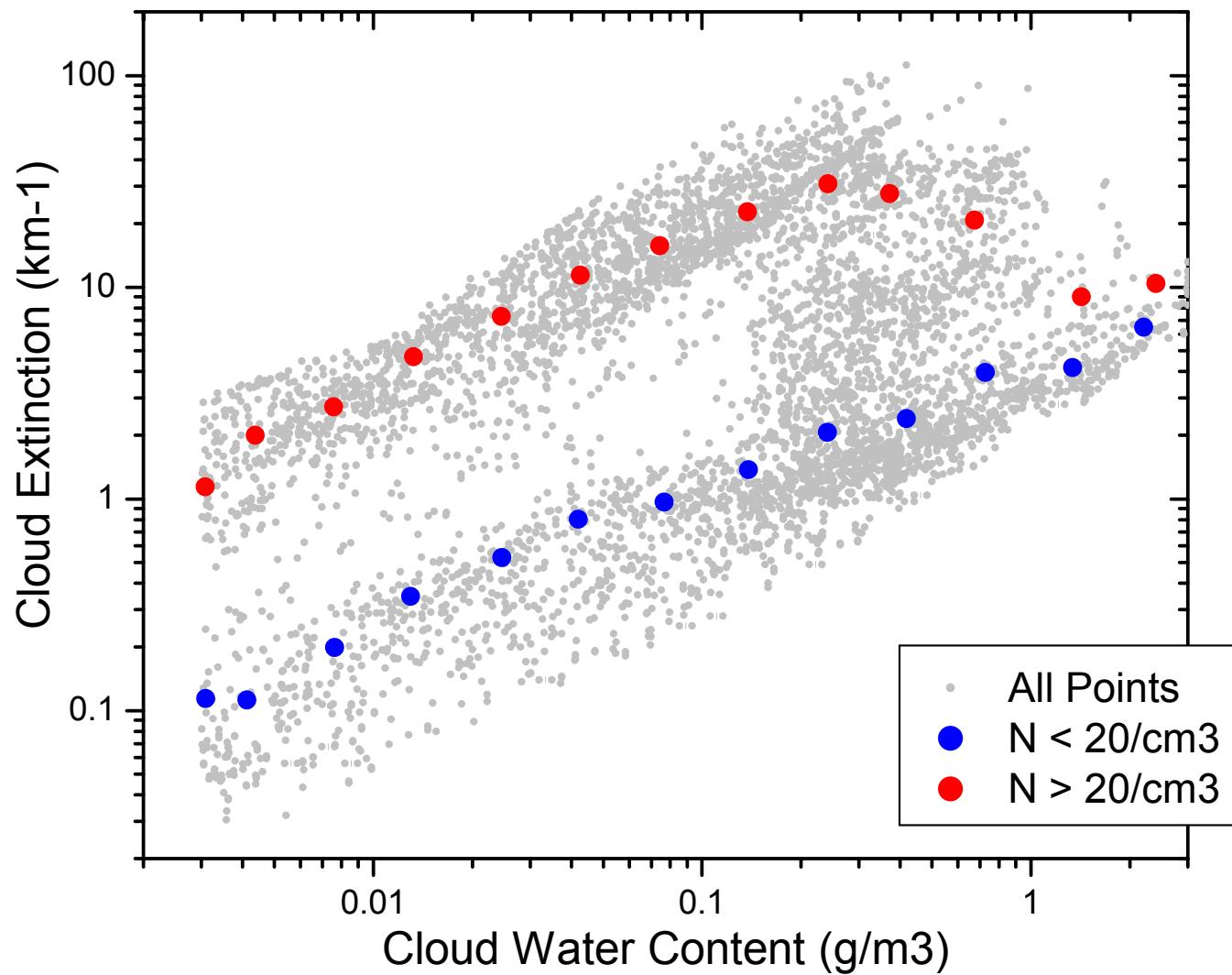


# Ice Cloud Relationship with Humidity



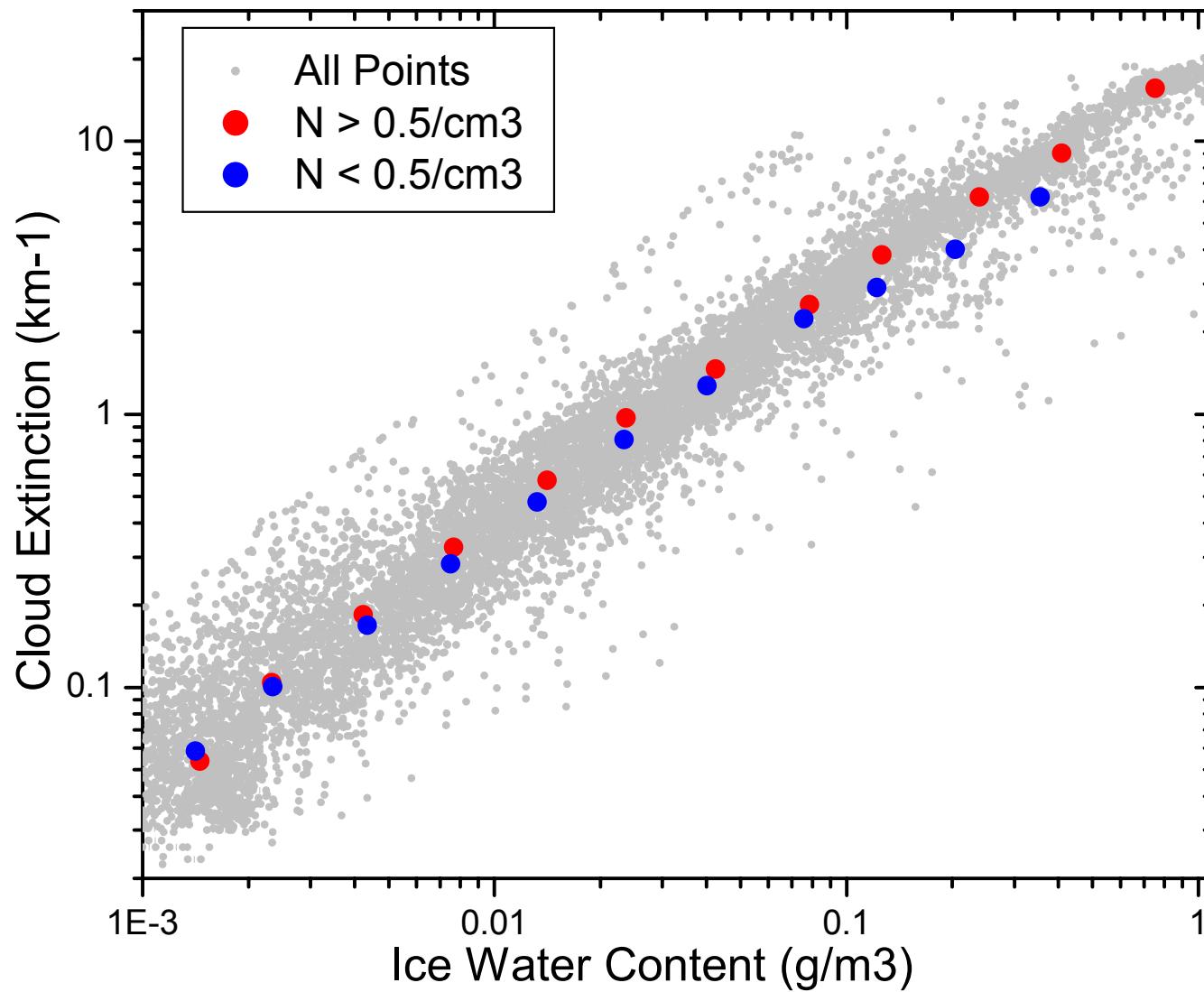


# Warm Cloud-Aerosol Interactions



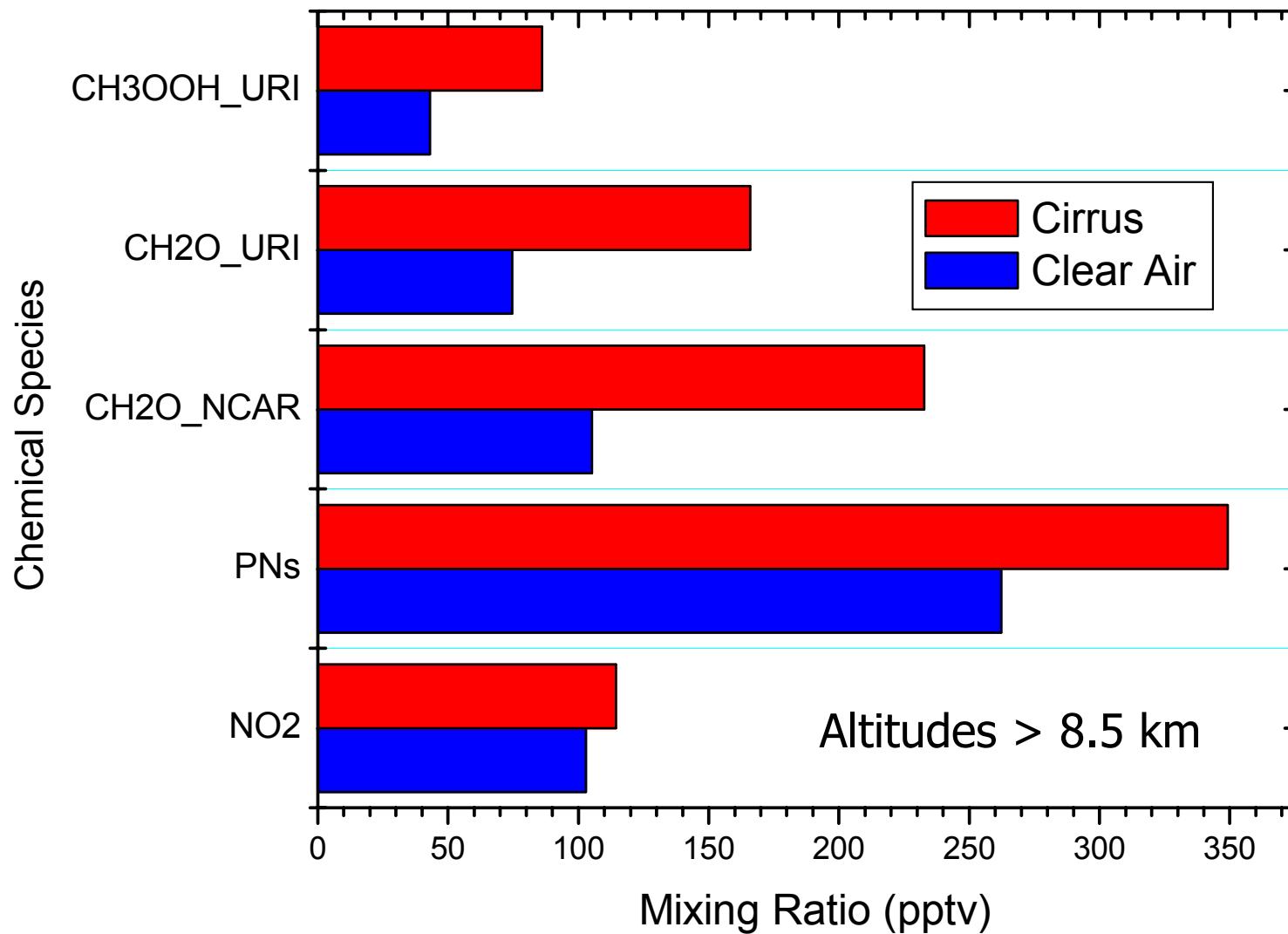


## Cirrus Cloud-Aerosol Interactions



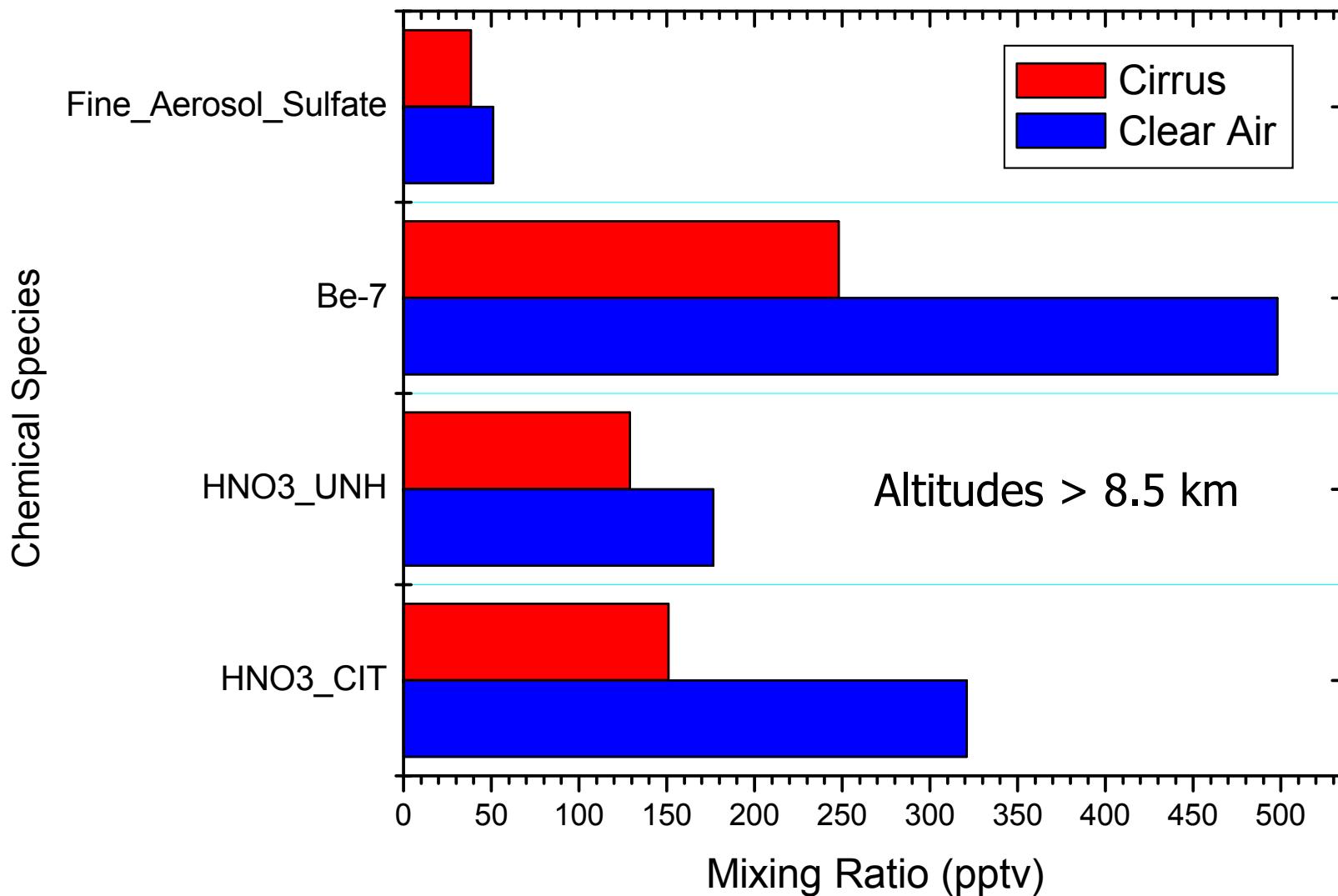


# Cloud Impact on Atmospheric Composition





# Cloud Impact on Atmospheric Composition





# INTEX-NA UV-DIAL Cirrus Observations

INTEX-NA

WCB Outflow & BAe146  
Flight 13

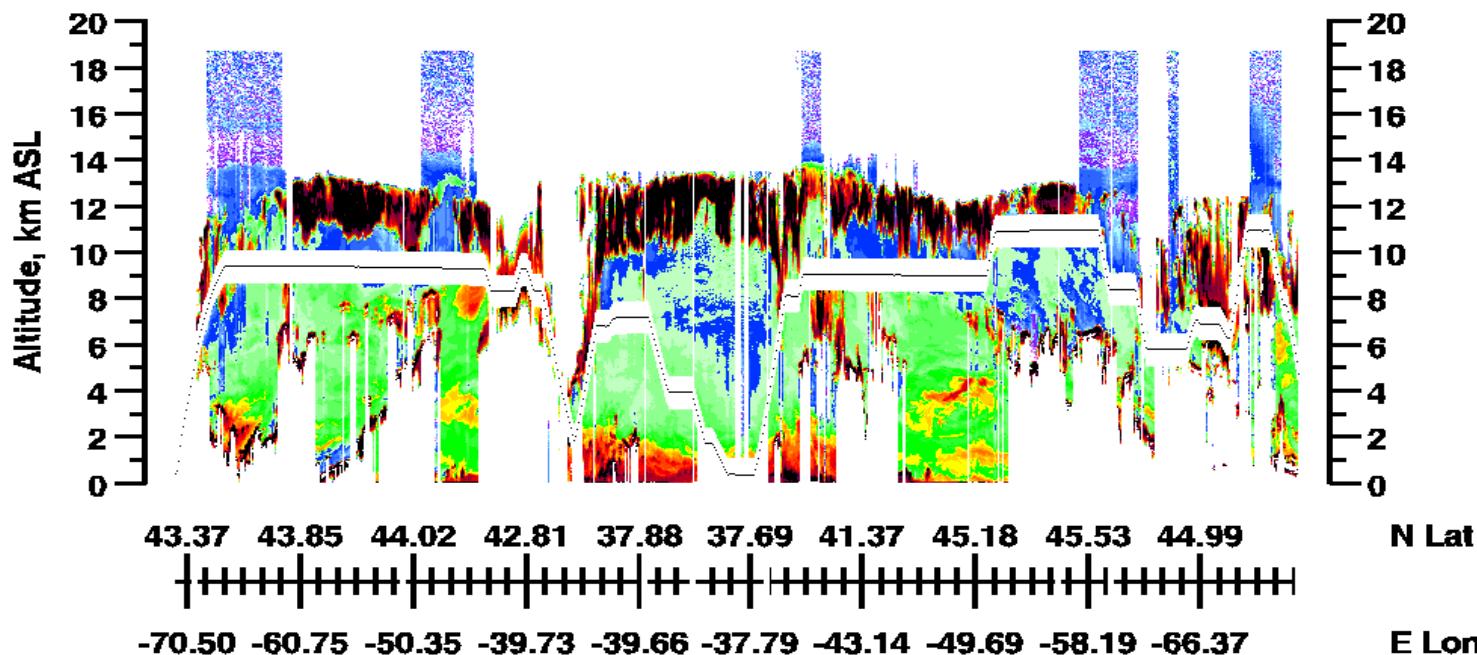
28 Jul 04

Aerosol Scattering Ratio (1064 nm)

0.01      0.1      1      10      50

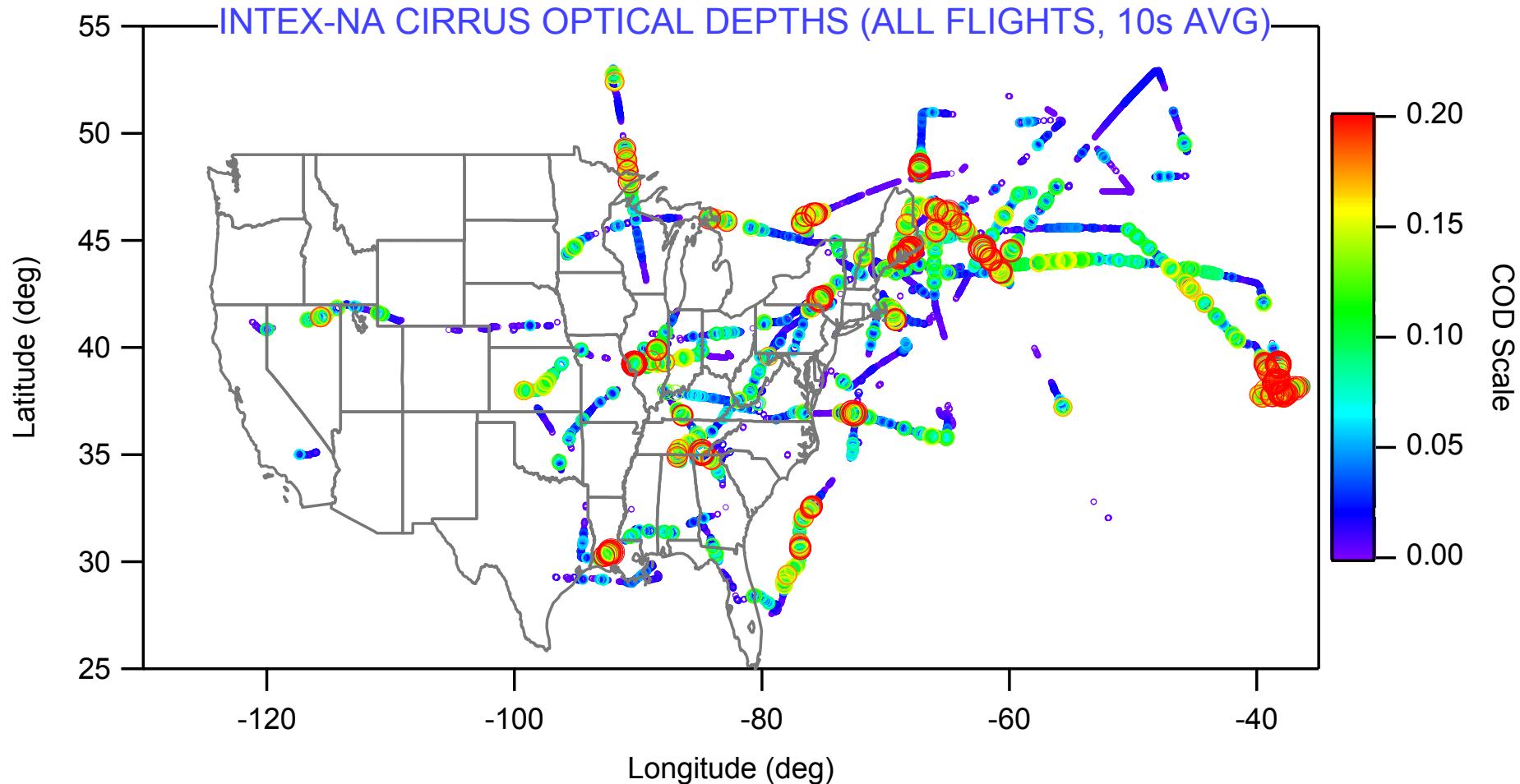


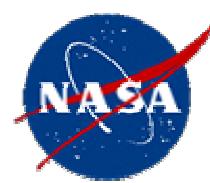
12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00      UT





# UV-DIAL Cirrus Cloud Optical Depths





## Remaining Tasks and Future Work

- Work with UH to complete DICE paper
- Apply more realistic density factors to ice particle data and recalculate ice water contents
- Work with UH (and others) to further develop characterization of aerosol sources and sinks, transformation processes and assess radiative impacts
- Continue cloud investigation, examining case studies, and performing lidar data interpretation more carefully
- Perform comparison of UV-DIAL extinctions with in situ observations to evaluate CALIPSO algorithms
- Work with Diskin/Sachse to develop better cloud microphysical sensors for INTEX-B